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PATENT COOPERATION TREATY

From the  
INTERNATIONAL SEARCHING AUTHORITY

To:  
SMART & BIGGAR  
P.O. Box 2999  
Station D  
OTTAWA, Ontario  
Canada, K1P 5Y6

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WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

(PCT Rule 43bis.1)

Date of mailing 05 July 2005 (05-07-2005)  
(day/month/year)

Applicant's or agent's file reference  
71493-1320

**FOR FURTHER ACTION**  
See paragraph 2 below

International application No.

**PCT/CA2005/000387**

International filing date (day/month/year)

15 March 2005 (15-03-2005)

Priority date (day/month/year)

15 March 2004 (15-03-2004)

International Patent Classification (IPC) or both national classification and IPC  
IPC<sup>7</sup> H04J-11/00

Applicant  
NORTEL NETWORKS LIMITED ET AL

1. This opinion contains indications relating to the following items :

- |   |              |  |
|---|--------------|--|
| <input checked="" type="checkbox"/> [X] | Box No. I    | Basis of the opinion   |
| <input checked="" type="checkbox"/> [X] | Box No. II   | Priority   |
| <input type="checkbox"/> [ ]            | Box No. III  | Non-establishment of opinion with regard to novelty, inventive step and industrial applicability   |
| <input checked="" type="checkbox"/> [X] | Box No. IV   | Lack of unity of invention   |
| <input checked="" type="checkbox"/> [X] | Box No. V    | Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement |
| <input type="checkbox"/> [ ]            | Box No. VI   | Certain documents cited  |
| <input checked="" type="checkbox"/> [X] | Box No. VII  | Certain defects in the international application   |
| <input checked="" type="checkbox"/> [X] | Box No. VIII | Certain observations on the international application  |

2. FURTHER ACTION

If a demand for international preliminary examination is made, this opinion will be considered to be a written opinion of the International Preliminary Examining Authority ("IPEA") except that this does not apply where the applicant chooses an Authority other than this one to be the IPEA and the chosen IPEA has notified the International Bureau under Rule 66.1bis(b) that written opinions of this International Searching Authority will not be so considered.

If this opinion is, as provided above, considered to be a written opinion of the IPEA, the applicant is invited to submit to the IPEA a written reply together, where appropriate, with amendments, before the expiration of 3 months from the date of mailing of Form PCT/ISA/220 or before the expiration of 22 months from the priority date, whichever expires later.

For further options, see Form PCT/ISA/220.

3. For further details, see notes to Form PCT/ISA/220.

Name and mailing address of the ISA/CA  
Canadian Intellectual Property Office  
Place du Portage I, C114 - 1st Floor, Box PCT  
50 Victoria Street  
Gatineau, Quebec K1A 0C9  
Facsimile No.: 001(819)953-2476

Date of completion of this opinion

16 May 2005 (16-05-2005)

Authorized officer

Corneliu Remes (819) 934-2675

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/CA2005/000387

Box No. I      Basis of this opinion

1. With regard to the language, this opinion has been established on the basis of:
  - ☒ the international application in the language in which it was filed
  - ☐ a translation of the international application into \_\_\_\_\_, which is the language of a translation furnished for the purposes of international search (Rules 12.3(a) and 23.1(b)).
2. With regard to any nucleotide and/or amino acid sequence disclosed in the international application and necessary to the claimed invention, this opinion has been established on the basis of:
  - a. type of material
    - ☐ a sequence listing
    - ☐ table(s) related to the sequence listing
  - b. format of material
    - ☐ on paper
    - ☐ in electronic form
  - c. time of filing/furnishing
    - ☐ contained in the international application as filed.
    - ☐ filed together with the international application in electronic form
    - ☐ furnished subsequently to this Authority for the purposes of search.
- 3 ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table(s) relating thereto has been filed or furnished, the required statement that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.
4. Additional comments :

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/CA2005/000387

Box No. II      Priority

1. ☐ The validity of the priority claim has not been considered because the International Searching Authority does not have in its possession a copy of the earlier application whose priority has been claimed or, where required, a translation of that earlier application. This opinion has nevertheless been established on the assumption that the relevant date (Rules 43bis.1 and 64.1) is the claimed priority date.
2. ☐ This opinion has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid (Rules 43bis.1 and 64.1). Thus for the purposes of this opinion, the international filing date indicated above is considered to be the relevant date.
3. Additional observations, if necessary :  
The priority documents support the independent claims.

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/CA2005/000387

Box No. IV Lack of unity of invention

1. ☒ In response to the invitation (Form PCT/ISA/206) to pay additional fees the applicant has, within the applicable time limit :

- ☐ paid additional fees
- ☐ paid additional fees under protest and, where applicable, the protest fee
- ☐ paid additional fees under protest but the applicable protest fee was not paid
- ☒ not paid additional fees

2. ☐ This Authority found that the requirement of unity of invention is not complied with and chose not to invite the applicant to pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☐ complied with
- ☒ not complied with for the following reasons :

Claims 1 - 44, 46 - 48 refer to:

- a) methods of transmitting over four transmit antennas comprising: for each antenna, generating a respective sequence of OFDM symbols, each OFDM symbol having a plurality of sub-carriers carrying at data or pilots, and transmitting the sequence of OFDM symbols; wherein pilots are inserted for the four antennas collectively; and
- b) apparatuses comprising four antennas and implementing one of the above methods.

Claim 45 refers to:

a method of transmitting a pair of identical OFDM symbols comprising: transmitting a prefix; transmitting a first OFDM symbol having first and second portions in time, the second portion being identical to the prefix; and transmitting a second OFDM symbol identical to the first OFDM symbol.

4. Consequently, this opinion has been established in respect of the following parts of the international application :

- ☐ all parts
- ☒ the parts relating to claim Nos. 1 - 44, 46 - 48

**WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY**

International application No.  
PCT/CA2005/000387

**Box No. V Reasoned statement under Rule 43bis.1(a)(i) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement**

**1. Statement**

Novelty (N)	Claims 1 - 44, 46 - 48	YES
	Claims NONE	NO
Inventive step (IS)	Claims 3, 9, 14, 18 - 20, 26 - 29, 35, 41, 42	YES
	Claims 1, 2, 4 - 8, 10 - 13, 15 - 17, 21 - 25, 30 - 34, 36 - 40, 43, 44, 46 - 48	NO
Industrial applicability (IA)	Claims 1 - 44, 46 - 48	YES
	Claims NONE	NO

**2. Citations and explanations :**

Reference is made to the following documents:

D1: US20030072254 A1

D2: US20030072255 A1

**NOVELTY**

1. Claims 1 - 44, 46 - 48 are considered to be novel under PCT Article 33(2) because the prior art does not teach methods of transmitting over four transmit antennas comprising: for each antenna, generating a sequence of OFDM symbols including data and pilots, wherein a) pilots are inserted for the four antennas collectively in blocks of two sub-carriers by two OFDM symbols scattered in time and frequency; or b) pilots are arranged in groups of four consecutive pilots in time, each group containing pilots for the four antennas; or c) the OFDM symbols include at least one preamble or midamble OFDM symbol, comprising a repeating pattern of four pilot sub-carriers for the four antennas.

**INVENTIVE STEP**

1. Document D1 discloses, in terms of the claims in the present application, a method of transmitting over two or more transmit antennas (paragraph [0045]) comprising: for each antenna, generating a sequence of OFDM symbols including data and pilots (abstract, paragraph [0060]), wherein a) pilots are inserted for two antennas collectively in blocks of one sub-carrier by two OFDM symbols scattered in time and frequency (paragraphs [0008], [0017], [0023]); or b) pilots are arranged in groups of two consecutive pilots in time, each group containing pilots for two antennas (figures 5, 6); or c) the OFDM symbols include at least one preamble OFDM symbol (paragraph [0060]), comprising a repeating pattern of two pilot sub-carriers for two antennas (figure 5). The pilot symbols are inserted alternately in time using a first plurality of equally spaced sub-carrier positions and a second plurality of equally spaced sub-carrier positions, which are offset from the first plurality of equally spaced sub-carrier positions by half the spacing between adjacent sub-carriers of the first plurality of sub-carrier positions (paragraphs [0030], [0031]). The pilots may be STBC (Space-Time Block Coding) coded (paragraph [0060]) and transmitted with a higher power than average power (paragraphs [0028], [0076]). The pilot sub-carriers are modulated by pilot symbols generated by QPSK. The data sub-carriers are modulated by complex data symbols generated by QAM mapping (paragraph [0060]). The OFDM symbols include at least one preamble OFDM symbol comprising a repeating pattern (paragraph [0060]). In order to minimize interference at the receiver between the pilot symbols of each transmitting antenna, each transmitting antenna typically switches its pilot pattern on and off (paragraph [0020]).

2. Document D2 discloses, in terms of the claims in the present application, a method of transmitting over N transmit antennas (paragraphs [0018], [0114]) comprising: for each antenna, generating a sequence of OFDM symbols including data and pilots (paragraph [0014]), wherein a) pilots are inserted for two antennas collectively in blocks of two sub-carriers by two OFDM symbols (figures 5, 6; paragraph [0026]); or b) pilots are arranged in groups of two consecutive pilots in time, each group containing pilots for two antennas (figures 5, 6); or c) the OFDM symbols include at least one preamble OFDM symbol (paragraphs [0026], [0028], [0106]), comprising a repeating pattern of two pilot sub-carriers for two antennas (figure 5). The method further includes transmitting at least one fixed signalling channel for the antennas (paragraphs [0015], [0033], [0108]). The duration of one OFDM symbol is determined by the transmission environment characteristics, e.g., the maximum channel delay and the maximum Doppler (paragraph [0109]). The OFDM symbols include at least one preamble OFDM symbol comprising a

(continued in Supplemental Box)

WRITTEN OPINION OF THE  
INTERNATIONAL SEARCHING AUTHORITY

International application No.  
PCT/CA2005/000387

**Box No. VII**      **Certain defects in the international application**

The following defects in the form or contents of the international application have been noted :

1. Typographical errors:

- p.11, line 9: "which included ... they doe not" instead of --which are included ... they do not--;
- p.12, lines 9-10: "can function similar" instead of --can function similarly--;
- p.15, lines 16-17: "another example pilot" instead of --another example of pilot--;
- "each pilot pairs is" instead of --each pilot pair is-- (claim 7);
- "comprising each comprising" instead of --comprising each-- (claims 9, 14);
- "comprising: for antenna" instead of --comprising: for each antenna-- (claim 11);
- "IME" instead of --TIME-- (figures 4A, 5A, 5B, 7A, 11-13, 14A, 15, 16A);
- reference character "20" instead of --420-- (figure 15); and
- reference character "50" instead of --450-- (figure 16A).

2. The expression "Following claim covers 2 or more antennas" on page 44 between claims 43 and 44 is not a claim and, therefore, should be removed.

**Box No. VIII**      **Certain observations on the international application**

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made :

**1. CLAIM-RELATED OBJECTIONS**

1.1 The following claims do not meet the requirements of Article 6 PCT since they are not clear.

Claim 3: the expressions "a repeating pattern of two pilot sub-carriers" on lines 24-25 and "ten data sub-carriers" are doubly included, i.e., they have already been defined previously in the claim. The afore-mentioned expressions should therefore be referred to using definite articles.

Claim 5: lack of antecedent "the same position".

Claim 27: ambiguous expression "relatively reliable signalling channel information" (our emphasis).

Claim 43: this claim cannot recite un-coded pilots, since it depends on claims 40-42, which recite coded pilots.

1.2 The following claims do not meet the requirements of Rule 6.4(a) PCT, which requires that multiple dependent claims not serve as a basis for any other multiple dependent claim: 21, 24 - 27, 29, 36, 37, 43.

**2. DESCRIPTION-RELATED OBJECTIONS**

The description does not comply with Article 5 PCT, which requires that the patent specification be sufficiently clear and complete.

2.1 The following acronyms and symbols are not explained :

p.20, lines 30: MAC and BS;

p.21, line 7: VB;

p.30, line 16: STBC;

p.32, line 9, and p. 33, line 7: BTS;

symbol K in the expressions "2K sequence" on p. 35, line 7, and "1K sequence" on page 35, line 9; and

symbol "\*" in the transmit sequences on p.35, lines 19, 21, 23, 25

2.2 There is inconsistency in variable notation: it is not clear if variable "m" on line 1 of p.22 is the same as variable "M" on line 3 of p.22; if this is the case, then the variable notation is inconsistent.

**3. DRAWING-RELATED OBJECTIONS**

Figures 7B, 9B, 10B, 10C, 14B, 16B contain unlabelled ordinate axes and figures 10B, 10C contain unlabelled abscissas, and hence do not comply with Rule 11.11(a) PCT, which requires that diagrams include short catchwords indispensable for understanding.



**Supplemental Box**

In case the space in any of the preceding boxes is not sufficient.

Continuation of: Box No. V

repeating pattern of pilot sub-carriers, with one pilot for each of N transmit antennas. An OFDM frame starts with a preamble, which consists of several identical header OFDM symbols preceded by a prefix, which is a cyclic extension of the header (paragraph [0112]).

3. The pilots in document D1 are inserted in blocks of one sub-carrier by two OFDM symbols rather than two sub-carriers by two OFDM symbols. However, it would have been obvious to a person skilled in the art, wishing to extend the teaching in D1 from a two-antenna to a four-antenna transmission method, to add an adjacent sub-carrier to the original sub-carrier in the blocks of one sub-carrier by two OFDM symbols. This approach is shown in figure 5 in document D2.

Other features which are not specifically mentioned in document D1, such as the inclusion in the preamble of a repeating pattern of four pilot sub-carriers for the four transmit antennas, fixed signalling channel, and maximum Doppler frequency and channel delay are also found in document D2. In addition, features such as using a single pilot instead of two pilots for each antenna, and implementing the claimed methods in at least two base stations or two mobile stations are well within the capabilities of a person skilled in the art.

Therefore, the subject matter in claims 1, 2, 4 - 8, 10 - 13, 15 - 17, 21 - 25, 30 - 34, 36 - 40, 43, 44, 46 - 48 does not involve an inventive step in view of D1 and D2 under PCT Article 33(3).

However, the combination of features in claims 3, 9, 14, 18 - 20, 26 - 29, 35, 41, 42 is not disclosed in nor rendered obvious by the available prior art.

**INDUSTRIAL APPLICABILITY**

Claims 1 - 44, 46 - 48 are considered to have industrial applicability under PCT Article 33(4).